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ABSTRACT

This report reviews mathematics education research that has taken place in New Zealand from 1975 to 1979. Eighty-two projects or papers are identified, classified, and listed. The classification reveals that 64 of the studies dealt with curricula, methods, and materials, 41 of these at the secondary level. The other two major categories of research identified were teaching and the teacher, with four activities, and learning and the learner, with 14 papers and projects. A second analysis of New Zealand mathematics education research shows eight activities were undertaken by students, seven by primary school staff, 36 by secondary personnel, six by teachers' college staff, 19 by University personnel, and six by departmental officers. The exploration of research by teachers is encouraged as a tool for personal and professional growth and is viewed as a benefit to the self-image and public image of the profession. A bibliography of the 82 studies and a separate listing of reported mathematics education-related activities during 1975-1979 concludes the document. (MP)

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Mathematics Education Research in New Zealand

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Before the nineteen sixties the teaching of mathematics received little critical evaluation or scientific study anywhere in the world. There have, of course, always been critics of the teaching of mathematics, but they have rarely, until recently, offered evidence to support their subjective judgements. Now, mathematics education research is developing into a discipline in its own right. An extensive international literature has emerged. Journals such as *The International Journal of Mathematics Education in Science and Technology*, *The Journal for Research in Mathematics Education*, *Educational Studies in Mathematics*, *The Journal of Childrens Mathematical Behaviour*, and *Problem Solving*, have all commenced publication in the last decade or so and carry a considerable volume of research-oriented material.

International organisations have been formed. The International Commission on Mathematics Instruction has held three Congresses, the fourth is to take place during 1980. Other groups such as The International Group for the Psychology of Mathematics Education and the International Study Group for Mathematics Learning have been established. Postgraduate programmes in Mathematics Education have become commonplace in universities around the world.

There can be little doubt that the stimulus for this activity has been the curriculum reform movement of the 'new mathematics'. While the movement was initially based on somewhat subjective judgements

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about content, reformers have been asked to demonstrate that their changes produced improvements in the classroom. In addition, the controversy which the changes produced has drawn new scholars to the field and made educators realise that research in mathematics education is an essential adjunct to curriculum reform in the area.

New Zealand was relatively cautious in its reactions to the curriculum changes and has also been slow in making positive movements in the research area. There are, however, signs of increasing activity and this paper will seek to summarise the character of this activity and to suggest future directions.

The Nature of Research

There is no obvious set of criteria by which work may be judged to qualify for the title of 'research' and so might be included in a 'state of the art' paper. We could insist that the research has an appropriate theoretical background, that experimental controls are employed, that every possible test is made to validate the procedures employed, the data collected and the conclusions reached, and that the researcher is very well prepared in the field in which the research is undertaken. If we did this then this paper would be a very short one. It seems more appropriate, in a developing area, to be liberal in our interpretation and to include, and hence encourage, activities which may lack the sophistication of a true research project but which are genuine attempts at what in UNESCO (1972, p.129) is described as 'disciplined inquiry'.

Many such activities have the potential to be developed to a stage where they might suggest generalisations, principles, or theories and so fit into a more formal definition of research.

A Review of Recent Research Activity

In order to collect information on activities, over the last five years, within this broad interpretation of the term 'research', requests were sent to each District Senior Inspector of Primary Schools, to each of the Mathematical Associations and to each Teachers' College. In addition the *New Zealand Mathematics Magazine* and the *Newsletter of the New Zealand Mathematical Society* were asked to carry requests for information. A survey of New Zealand educational and mathematical publications over the period was also undertaken.

As a result, 82 papers or projects were identified and these are listed at the end of this paper in the *Bibliography 1975 - 1979* and in the table of other reported activities.

Classification of this information presents some difficulties since no matter what classification is chosen there will be studies which cross the boundaries. After some experimentation, it was decided to classify first by institutional setting, using a category of 'General' for studies which failed to fall into any other single category, and then by area of research, using the UNESCO (1972) categories of (a) curricula, methods and materials, (b) teaching and the teacher, and (c) learning and the learner. Since these categories are not mutually exclusive, subjective judgements had to be made in a number of instances as to the major emphasis of the study. The results of the classification are shown in Table 1.

Table 1: An Analysis of the Number of Papers and Projects on Mathematics Education in New Zealand, 1975-1979

	Curricula, Methods and Materials	Teaching and the Teacher	Learning and the Learner	Total
Preschool	-	-	-	-
Primary	8	-	4	12
Secondary	41	1	3	45
Tertiary	11	1	5	17
General	4	2	2	8
Total	64	4	14	82

Clearly, the most popular area of research is that of curricula, methods and materials. Of the 64 studies in this area, 27 were concerned with various aspects of individualised instruction, 14 with assessment procedures, 8 with studies of the curriculum itself, and the remaining 15 with a variety of organisational procedures and material for the classroom.

The lack of activity in the teacher section is, perhaps, a reflection of the difficulties which have been experienced by New Zealand schools in recruiting well qualified mathematics teachers. This has

led to attempts to design 'teacher proof' programmes and to an attitude which regards the teacher as an 'intervening variable' in studies of mathematical learning. The concentration of effort on developing structured mastery learning programmes is further evidence for this view.

The most significant feature of the studies concerned with the learner is the level of sophistication of the projects which is noticeably higher than in the other areas. To some extent this reflects the difficulties associated with research in the area, but it is interesting to note that the majority of thesis work is included in this section.

The distribution by institutional setting shows considerable activity in the secondary field. There can be little doubt that a considerable proportion of this work is a result of the stimulus provided by the Mathematical Associations around the country. That there is so much effort in the tertiary field is also encouraging, this would certainly not have been the case ten years ago. The lack of preschool projects is disappointing, but the area of mathematics education is not well defined at this stage of development, and this may, in part, account for the complete absence of identifiable material.

A further classification of the 82 projects was made according to the occupations of the researchers. This information is presented in Table 2. The category 'Student' was used if the study was part of a formal course requirement, regardless of the occupation of the student concerned.

Table 2: An Analysis of the Number of Studies Undertaken by Researchers in Different Occupational Groups

Student	8
Primary school staff	7
Secondary school staff	36
Teachers' College staff	6
University staff	19
Departmental officers	6
	82

There are two major features which emerge from this analysis. Firstly, it is clear that there is a significant body of teachers, particularly in the secondary service, who are willing to be involved in mathematics education research. Secondly, it is worth noting that all but one of the studies undertaken by university staff were by members of Mathematics, rather than Education, Departments. This indicates a significant swing, by the universities, towards the acceptance of subject education research by staff as a valid academic pursuit, equal in status to research into the discipline itself.

The I.E.A. Second Study in Mathematics

In trying to identify particularly significant individual projects, the first obvious contender is the New Zealand involvement in the Second Study of Mathematics by the International Association for the Evaluation of Educational Achievement (Garden, 1979). The scope of the study is extremely wide covering surveys of attitude and achievement of pupils, of factors assumed to affect achievement, of background and attitudes of teachers and of the methods they employ, and of school and community characteristics. All of these will be analysed against a detailed analysis of the curriculum.

Survey research of this kind always poses at least as many questions as it answers and there are already many possibilities for research suggested by the progress reports. We may be proud that New Zealand is playing the key role in this international project and should be prepared to make the most of the information and stimulus which it will provide.

The Evaluation of Instructional Programmes

The other recent work which may turn out to be of particular significance is that of Dr Murray Coppen (1978) on the evaluation of individualised mathematics programmes. In view of the number of studies in this area, Dr Coppen's discussion of the conceptual and methodological problems associated with the evaluation of innovative instructional techniques or materials is particularly important and his suggested alternative research paradigm using a general systems theory analysis approach has exciting possibilities.

Mathematics Education Research and the Teacher

The most important overall feature which emerges from the analysis is, perhaps, the involvement of teachers. This may well hold the key to the future direction of research in the country. In his summary of the discussion which took place during the session on research related to the mathematical learning process at the Third International Congress on Mathematical Education, Skowronek writes:

> In the manner of a realistic utopia, we could imagine the teacher as a classroom researcher examining in concrete teaching situations the specific problems raised by the integration
>
> - of the content structure,
> - of the cognitive structure of the learner,
> - of the structure and organisation of teaching.
>
> (1977, p.245)

New Zealand is, of course, far from this 'realistic utopia', but has perhaps made the first steps towards it. We need, however, to be quite sure that these steps are in the right direction. Looking at the character of the studies undertaken by primary and secondary teachers we see that all except one of these are in the area of curricula, methods and materials. There is nothing wrong with this, of course, but it must be recognised that anything other than subjective judgement on the effectiveness of instructional methods or materials is extremely difficult to achieve. Reading most of the contributions in this area, one receives the distinct impression that teachers are seeking programmes which are not only 'teacher proof' but also 'pupil proof' and in some completely general sense 'better' than existing practice. The premise that one programme may be said to be 'better' than another, and hence that there is a 'best method' of teaching is at least debatable if not patently false in that it ignores the variability of the students. In this context Skowronek writes:

> Numerous studies of mathematics learning are mostly statistical in character and accordingly focus on average achievements and learning results, not on learning processes, thus tending to conceal the decisive recognition that mathematical 'insight' or mathematical understanding may be achieved in individually highly different learning processes.
>
> (1977, p.243)

It is an understanding of these individual learning processes which is the major requirement of the discipline of mathematics education. Skowronek again writes:

> Not until a comprehensive description of the individual acquisition processes operating in teaching has been provided, will it be possible to make the first attempts at a formulation of a comprehensive theory of mathematical learning.
>
> (1977, p.244)

Certainly the teacher should be encouraged to develop new approaches, materials and methods in the classroom, but there is a need for a greater awareness, and disciplined study, of the very different effects these methods and materials will have on individuals. Successful research into individual learning processes is not easy - certainly much more difficult than statistical research, which comes relatively easily to mathematicians. It requires skilled observational and interviewing techniques which can be developed as a result of a combination of training and experience. But given this experience and training, teachers are in a much better position to undertake this kind of research than any professional researcher or graduate student, simply because they are constantly in touch with the learning situation. Teachers can respond immediately, in a disciplined way, to cues from individual pupils that significant changes in learning behaviour have taken place. A planned, formal research project is much less likely to identify these important discontinuities in behaviour.

If teachers are to take this key role in research, then opportunities must be made for them to acquire the necessary skills, both by pre-service and in-service training. Teachers Refresher Courses, for example, have traditionally concentrated on curriculum matters. There seems to be a good case for courses in research techniques of all kinds. It may seem foolish, at a time when, we are told, teachers are leaving the profession in droves, to suggest yet another task to be undertaken in the classroom. But the evidence of this survey is that there are teachers who would welcome the opportunity for professional and personal growth through research and this kind of growth

could only benefit both the self image and the public image of the profession.

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